THE INSTITUTE SPOKESMAN

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Arthur J. Daniel to N. L. G. I. Board

To fill the vacancy on the Board of Directors caused by the death of Mr. J. R. Battenfeld, the Board elected Arthur J. Daniel, new President of Battenfeld Grease and Oil Corporation, to fill the unexpired term or until September 30, 1948.

Mr. Daniel has been associated with the Lubricating Grease Industry for a number of years, having a position with the Stevens Grease and Oil Company of Missouri, at Kansas City in 1916. He was a partner, Vice-President, and Secretary of the Battenfeld Company when it was formed in March, 1919. Mr. Daniel has been a Vice-President and General Manager until his recent election to the Presidency.

Mr. Daniel comes to the N. L. G. I. Board with an intimate knowledge of the Institute's activities and programs through the years because he attended the first organizational meeting of the N. L. G. I. and has attended every annual Convention since.

N. L. G. I. Board of Directors Meet

At the Hershey Hotel, Hershey, Pa., on Monday, June 16, 1947, the Board of Directors of the N. L. G. I. held its third meeting of the year. 13 Directors were present in person or by proxy. President H. P. Hobart presided. The full day was spent in consideration of 25 items which made up the agenda for the meeting.

The N. L. G. I. Executive Committee is scheduled to meet at the Hotel Traymore at Atlantic City, N. J., Friday September 19, 1947.

Battenfeld Elects New Officers

The Battenfeld Grease and Oil Corporation, Kansas City, Missouri, announces the election of the following officers:

Mrs. J. R. Battenfeld, Chairman of the Board;

Mr. A. J. Daniel, President;

Mr. Ralph R. Matthews, Executive Vice-President;

Mr. Paul R. Battenfeld, Vice-President;

Mr. Ray W. Timberlake, Vice-President;

Mr. E. E. Ellis, Secretary;

Miss Vera Mae Douglas, Assistant Secretary;

Mr. W. H. Ward, Treasurer.

Two new members were added to the Board of Directors, Mr. E. E. Ellis and Mr. Albert F. Hillix, both of Kansas City.

The INSTITUTE SPOKESMAN

Published monthly by
THE NATIONAL LUBRICATING GREASE INSTITUTE

CARL E. BOLTE ..... *Editor*
4638 Millcreek Parkway
Kansas City 2, Mo.

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President's Column . . .

H. P. Hobart, President N.L.G.I.

The production of lubricating grease as a light manufacturing industry has proved both popular and attractive to many, as evidenced by the figures of the U. S. Census Bureau which show that the 95 grease manufacturers in the United States reported for the year 1919 had increased to 350 by 1939. This is an increase of 268 per cent for that 20-year period, during which the volume of grease produced increased approximately 127 per cent.

U. S. Census Bureau figures subsequent to 1939 are not yet available.

However, reflecting the greatly increased demand for greases during the war, it is estimated that there are now more than 400 separate concerns in the United States manufacturing lubricating grease in one form or another and that the volume of grease produced in this country during the current year will exceed 1,000,000,000 pounds, valued at more than $50,000,000.

These figures show that the business of manufacturing grease is in itself quite an industry.

Technological improvements are continually being made, and a great many new special types of greases have been developed during the last few years. With the development of these new greases to meet new requirements in the automotive and industrial fields, new markets are opened up and a healthy growth for the industry seems assured as a result of the progressive spirit of most grease manufacturers.

Practically all refiners manufacturing lubricating oils make their own greases. Many blenders and compounders of lubricating oils also manufacture grease. There are many plants devoted solely to the manufcature of grease and others which also manufacture specialties of one kind or another.

The figures quoted above showing the percentage growth in the number of companies manufacturing grease in the United States, with less than half of that percentage increase in the amount of grease produced up to 1939, shows clearly the rapid growth in the number of smaller concerns manufacturing grease. During the war period, and subsequently, this increase has probably been at an even faster rate.

Many manufacturers of greases have materially added to their business by the manufacture also of various types of rust preventive compounds. Many of these products resulted from the tremendous war demand for rust preventives, especially for equipment going into South Sea areas.

It has been estimated that the preventable damage to various articles made of iron and steel runs into hundreds of millions of dollars per year in this country alone. This indicates that even the peace-time market for rust preventatives in the United States could be developed to tremendous volumes with the proper educational and sales campaign.

There are many other types of specialties the manufacture of which can readily be undertaken by the grease manufacturer.

In the automotive field approximately 1.125 pounds of grease for chassis lubrication are consumed for every 2.5 gal-

Continued on page 8

60TH YEAR! 1887-1947 60TH YEAR!

TROPHY

TIME REVEALS THE TRUTH —

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The Pioneer Grease Manufacturer in the Upper Midwest

"STRONTIUM GREASES" for Makers of Lubricating Compounds

BY H. J. WORTH AND L. W. McLENNAN
Research Department, Union Oil Company of California

About the Authors

Mr. Worth was born in Nebraska on March 6, 1911. He obtained his elementary and high school education in Everett, Washington. He received his university education at the University of Washington in Seattle, where he was granted a B. S. degree in 1940 and an M. S. degree in 1942.

After graduating from the university, Mr. Worth came directly to the Research Department of the Union Oil Company of California at Oleum, Calif. His work has dealt principally, but not exclusively, with lubricating oil greases. Mr. Worth's contributions in the development of strontium grease, both in the laboratory and on commercial basis, have been outstanding, important, and highly commendable.

Mr. Worth is married and lives at Rodeo, California. His principal hobby is gardening.

Mr. McLennan was born in Canada in 1900 and received his elementary and high school education in Vancouver, Canada. After completing his undergraduate work in chemistry, he graduated (B. A.) from the University of British Columbia in 1922. The following three years (1922-1925) were spent at Oxford University in England, doing graduate research work. After graduating in 1925 (B. Sci.), he became associated with the research group of the Koppers Co., in Pittsburgh, Pa., until 1927. During 1927-1928, Mr. McLennan held a teaching fellowship at the University of California. In 1928, he returned to industrial work with the Research Department of the Union Oil Co. of California and has been associated with this firm since that time.

Mr. L. W. McLennan of the Research Department, Union Oil Company of California, delivering this paper before the 14th annual N. L. G. I. Convention, Chicago, Illinois, October 1, 1946.

During the past 18 years, he has dealt with almost every problem in the field of petroleum refining. For the past years much of his work has related to lubricating oil greases and the various aspects of their formulation, manufacture, and testing. At the present time he directs the company's research laboratory at Oleum and in particular supervises research on greases. Probably the principal or major development in grease technology with which he has been intimately concerned has been the establishment of barium and strontium soap greases on a commercial basis. In both instances, he has participated in the development from the earliest stages to the realization of full commercial production. In addition to the foregoing, he is also very familiar with all types of lubricating greases currently marketed.

Mr. McLennan, as well as being a staunch supporter of the National Lubricating Grease Institute, is a supporter of various other scientific groups including the American Chemical Society and the A. S. T. M.

Apart from his research activities, his principal interests are in gardening, the theatre, and foreign affairs.

Introduction

During the past few years much thought and effort have been concentrated by research personnel upon possible improvements in grease technology. Such studies have related to all the various aspects of greases, including their formulation, manufacture, and testing. Some of the results have already appeared in printed form but undoubtedly many more remain to be published.

In the present paper the authors discuss some exploratory work in the field of new greases. Specifically the work relates to a new class of greases, the characteristics of which make them particularly useful for certain practical applications. These lubricants are designated as complex strontium greases, since strontium soaps are employed in a special manner to thicken lubricating oils. The complex strontium greases represent a new contribution to the art of grease manufacture.

In the development of the subject strontium greases, certain complications were encountered, which may be of interest to record at this time. For one thing, although strontium is not in fact a scarce metal*, the uses of it or its compounds heretofore have not been on as broad a scale as have been, for example, the compounds of calcium and barium. Consequently, in the earlier research work on strontium greases, it was quite difficult to establish a reliable source of commercial supply of strontium hydrate. Furthermore, the cost of strontium compounds at that time was high in comparison with that of most other metal compounds used in grease manufacture. After considerable effort, however, agreement was reached with a chemical manufacturer to maintain a special commercial stockpile of the hydrate for use in the subject investigation. Through virtue of this same arrangement, it was also ultimately possible to reduce the cost of the hydrate by roughly 50 per cent. The hydrate, which is generally used in compounding these greases, is available as crystalling $Sr(OH)_2.8H_2O$. It contains only a small percentage of impurities chiefly as carbonate and/or calcium and barium compounds.

Apart from the strontium hydrate discussed above, other compounding materials employed include the usual mineral oils and soap stocks, which can be varied widely. The conventional modifiers and additives can also be readily incorporated to improve the greases in respect to the

*Lithium and Strontium, New Tools for the Petroleum Industry, by W. F. Luckenbach, Jr., National Lubricating Grease Institute Convention, 1943.

resistance toward oxidation in storage and their protection of bearing surfaces against wear, seizure, and/or corrosion from moisture.

The equipment used in preparing the greases is of the conventional steam-jacketed type, provided with agitators and auxiliary equipment, and powered with a heavy duty motor, preferably of a variable speed type. The equipment should also be designed to operate at temperatures as high as approximately 500°F.

Several types of commercial strontium greases have been marketed to date for a number of special industrial purposes and such greases are now being regularly manufactured in 5-7 ton lots in plant equipment. It is clear, therefore that strontium base greases can now be considered as fully developed commercial products.

The Preparation of Complex Strontium Greases

The manufacture of the strontium greases is carried out in a reasonably straight forward manner, once the different variables are understood and suitable equipment is available. Although certain types can be prepared either by a batch or a continuous process, to date commercial production has been carried out upon a batch basis only. The formulation of the grease and the detailed procedure by which it is prepared will depend upon the purpose for which the grease is to be used.

The authors regret that at this time full details of compounding procedures cannot be presented, but such information will be disclosed in patents covering the subject greases, when and if granted. It can be stated, however, that one method of preparing the greases involves the reacting of excess hydroxide with a soap mass at elevated temperatures.

Strontium greases have been prepared from a very wide variety of soap stocks comprising such fats as prime tallow, lard oil, sperm oil, peanut oil, etc. In addition, the fatty acids employed have included such materials as tallow fatty acids, oleic acid, stearic acid, myristic acid, ricinoleic acid, acids from oxidized wax, etc. It will be noted, therefore, that the formulation of the grease is very flexible in respect to the soap stocks used.

The type of oil used can be varied virtually without practical restriction. Greases have been prepared with oils as low in viscosity as 55 SUS at 100° F., or as high in viscosity as 200 SUS at 210° F. Undoubtedly these viscosities could be extended if the need for less

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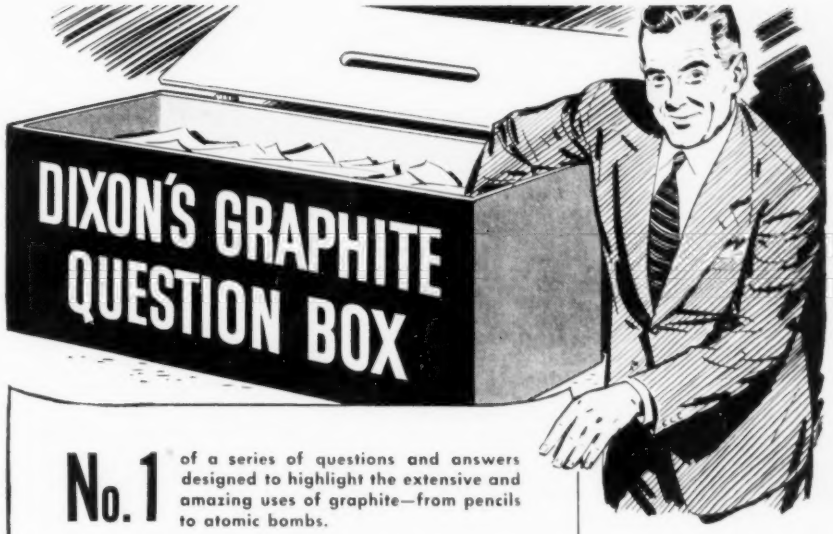

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ANS. A soft, unctuous, non-metallic mineral of the carbon family, its principal natural sources being Madagascar, Ceylon, Mexico and Korea.

QUES. How is graphite classified by type?

ANS. Natural crystalline is found in laminations of very thin flakes and in vein-like strata of foliated or fibrous structure. The natural amorphous type is of earthy structure, found in bedded deposits considered to be the result of metamorphisms of coal or carbonaceous materials.

QUES. Which type of graphite is obtainable in the highest purities?

ANS. The crystalline varieties, after refinement, run highest in graphitic carbon.

QUES. In what average particle sizes are processed graphites available?

ANS. Over an extremely wide graduated range, from an average of 2 microns to large flake sizes containing particles from 1/3 to 2 millimeters.

QUES. Are all these graphites — varying in type, purity and particle size — suitable for the same uses?

ANS. Definitely not. In almost every case the application governs the selection of graphite by type, purity and particle size. Lubricants, for example, require the crystalline types of highest purity. Electrical applications usually call for high purity. The lower purity grades of natural amorphous graphites find less exacting uses.

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viscous or more viscous oils were indicated. The viscosity index of the oil can be varied over as wide a range as that represented by the available lubricating oils on the market. For example, one commercial strontium grease contains a California solvent-treated oil of 100 SUS at 100° F. and of 20 VI, whereas another commercial strontium grease contains an oil of 150 SUS at 210° F., and of 105 VI. Technical white oils, residual oils of various types, lubricating oil distillates, lubricating oil extracts, etc., can be used if so desired.

The water content of the strontium greases is generally of a negligible magnitude, representing that which remains after essential dehydration of the batch, as in the case of many sodium base greases. In some instances, however, the deliberate incorporation of small percentages of water may serve to smooth the texture and improve the clarity of the product.

Various additives have been incorporated in strontium greases to impart enhanced oxidation resistance, anti-wear characteristics, extreme pressure characteristics, and rust inhibiting properties. In this respect the strontium greases are similar to other greases in that the use of the additives in reasonable amounts does not adversely affect their structure.

It is evident, therefore, that the manufacture of strontium greases offers a high degree of flexibility in many respects and experience to date has consistently served to confirm this observation. As further evidence along this line, it may be stated that the commercial production to date has been achieved with remarkable freedom from those discouraging irregularities and complications that so often crucify a technologist when initiating the large scale production of a new product.

The Properties of Complex Strontium Soap Greases

Strontium greases may be of either the buttery or fibrous types. In the case of the former type, the greases possess an unctuous texture similar to that of the more familiar calcium, sodium, aluminum, barium, and lithium greases. Depending upon formulation, the fibrous greases may exhibit a short or long fibre, as do the sodium and barium greases. Consequently, fibrous structures in greases is not restricted to sodium soap greases.

As in the case of other conventional type greases, the properties of strontium greases are determined to some extent by the type of oil or liquid vehicle used and by the characteristics of the saponifiable materials from which the soap or thickening agent has been made. For example, the temperature susceptibility or the temperature-viscosity relationship will be controlled in some measure by the viscosity index of the mineral oil or liquid used. The solvency of the oil for the particular soap used will also be a factor in respect to syneresis, thixotropy, etc. Likewise the characteristics of the saponifiable material used to prepare the soap will exert some influence upon the stability and the resistance to oxidation of the grease in storage, its stability at elevated temperatures, etc. Therefore a judicious selection of the correct mineral oil, saponifiable material, and other ingredients applies in the same measure to strontium greases as for other conventional greases. In the appended Table are presented test data for a series of representative strontium greases, showing the general properties of this type of grease.

The complex strontium greases are generally prepared as anhydrous pro-

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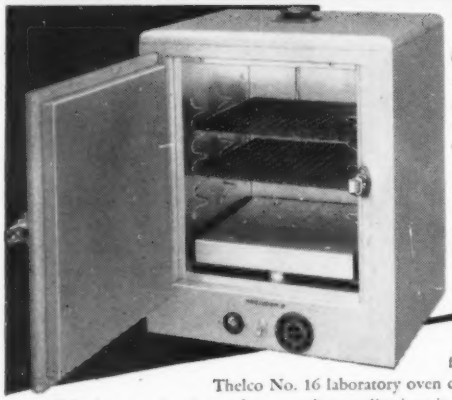
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ucts and in this respect they are comparable to sodium, lithium, barium, aluminum and certain calcium greases. In the case of strontium grease, as for the other grease types, small percentages of water can be used on occasions to obtain certain effects for specific purposes. The anhydrous strontium greases are reversible over wide temperature limits; that is to say, they can be heated and cooled continuously in service without any substantial change in grease structure and any marked change in consistency as a consequence thereof. Few greases possess this very desirable property. On the contrary, many greases are not reversible and upon heating to even moderately elevated temperatures, they undergo significant changes in physical structure or they lose their stabilizing agent. The consequence of such changes is that, in a bearing operating intermittently at atmospheric and or elevated temperatures, the re-cooled grease no longer resembles the original grease but may be much harder and exhibit marked syneresis. The anhydrous strontium greases are of the desirable reversible type.

Strontium greases resist the emulsifying and disintegrating effects of water, as in the case of the greases prepared from other alkaline earth metals, and they are therefore classed as water-resistant greases. This resistance is exhibited whether the water is at ordinary temperatures or at elevated temperatures with steam present. The greases also appear to offer considerable resistance to the leaching action of such light hydrocarbons as gasoline. The foregoing combination of properties is of interest and value in connection with the lubrication of air craft bearings, where steam and gasoline may be used in washdown operations. The subject strontium greases are not readily displaced by such cleaning operations.

Resistance to oxidation or breakdown of the strontium greases upon exposure to elevated temperatures is another valuable property of these greases. This resistance is due in part to the relative stability of the strontium soaps, although a proper selection of oil and soap stock is also important in formulating the high temperature greases. Grease F (See Table 1) is an example of such a formulation.

The relatively superior rust protective action of strontium greases, without rust inhibitors, has been exploited to advantage in protecting bearing or metal surfaces exposed to moisture or salt spray. The degree of protection is influenced to some extent by the method of preparation and ingredients used, as might be expected. Broadly speaking, the strontium greases as a group have shown superior merit in their relative rust protective action. Data of interest in this

Continued on page 9

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PRESIDENT'S COLUMN

Continued from page 3

lons of motor oil or 100 gallons of gasoline.

Practically every owner and driver of every type of automotive equipment, including passenger cars, trucks, buses, motorcycles, motorboats, airplanes, are directly interested in the purchase and use of grease. The average motorist usually makes his purchases through the gasoline service station in the form of chassis lubrication service. The truck, bus and motorboat operators more usually purchase grease in cans or drums. The point is that as many people are dependent upon grease as are dependent upon gasoline and motor oil.

In addition, the farmer has large requirements for grease and rust preventatives for his non-motorized equipment as well as for his power equipment.

In the industrial field practically every type of industry uses grease in one form or another for the lubrication of all types of machinery and mechanical equipment. Railroad transportation, the mining industry, the merchant marine, are all dependent upon grease.

In fact, lubrication is necessary for all forms of mechanized transportation and industry and the field for greases is practically as broad as that for lubricating oils.

Including all those associated with the petroleum industry, of which the grease industry is really a part, together with all those engaged in all forms of manufacturing activity, all forms of transportation, and the farmers, we conclude that more than 50,000,000 people in this country are directly or indirectly concerned with the advancement of the grease industry.

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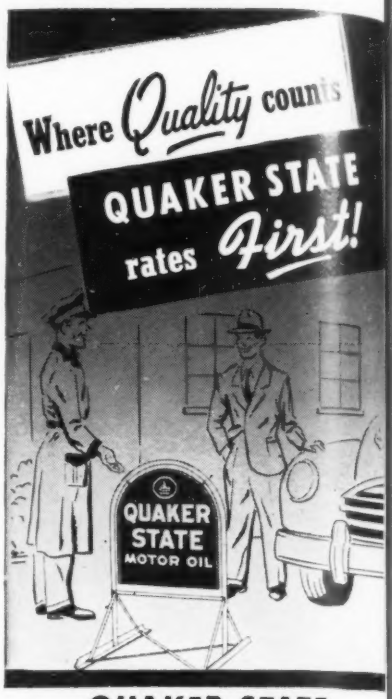

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"STRONTIUM GREASES" For Makers of Lubricating Compounds

Continued from page 7

connection are presented in the appended Table 2.

The subject strontium greases can be prepared, through the use of proper formulation and manufacturing procedures so that the faults of aerating excessively in service or breaking down markedly under mechanical working are eliminated or greatly minimized. Proper formulation of the greases also permits considerable control of their thixotropic properties.

Enhancing the greases in respect to oxidation resistance, anti-wear characteristics, and other specific properties has been achieved in essentially the same manner as for the more conventionel greases, namely, by the use of additives for the purpose.

It will be evident from the foregoing description of the properties of these greases, that they exhibit in an impressive degree the characteristics commonly desired in industrial greases. The unusual flexibility possible in their formulation with mineral oils is a property of considerable value. Further improvements are being made and will continue to be made in the quality of these new and interesting lubricants.

The Uses of Complex Strontium Greases

The knowledge of the preparation and the properties of a certain type of grease generally suggests the uses to which it can be put and the probable limitations

Continued on following page

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that may be encountered in such uses. This is also true in the case of the complex strontium greases. The following properties in particular are of interest in respect to uses to which these greases have been put to date:

(1) Their resistance to the disintegrating effects of water, at ordinary or elevated temperatures; their resistance to the leaching action of hydrocarbons.

(2) Their reversible character over wide temperature ranges, due to their anhydrous character and their freedom from gelation.

(3) Their superior protective action against moisture or salt spray corrosion.

(4) Their relative stability when used at high temperatures.

(5) The stability of their grease structure when subjected to mechanical working.

It is clear that the above combination of properties, supplemented by those special properties imparted as a result of the proper selection of the mineral oil and soap stock used, permits wide and effective application of this new class of grease. Although the greases can easily serve as general purpose lubricants, to date attention has been directed primarily to those uses wherein the greases can definitely demonstrate their superiority over other available greases, or where some novel application can be made. Development along this line is dictated for several reasons, an important reason being that the greases must justify their somewhat higher cost through their demonstrated superior service.

Among the many interesting applications of the strontium grease at high temperature is the use of Grease F (See Table 1) throughout the plants of two

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of the major rubber and tire manufacturers. Although the bearing speeds and loads varied over a wide range, the principal complicating factor was the bearing temperature, which ranged from 275° to 325° F. In the case of one plant, the use of this grease permitted the uninterrupted operation of the drying ovens. The bearings being lubricated were located within the ovens and were therefore subject to a temperature reported as approximately 325° F. and to an atmosphere of sulfur and solvent vapors. Previously, occasional bearing failures, attributable to rapid deterioration of other type lubricants used for the purpose, had necessitated unscheduled shutdowns. These shutdowns involved loss of valuable operating time and curtailment in production.

At one large smelter, the above Grease F demonstrated its merit for severe high temperature lubrication service by continuously lubricating the bearings of a Jacoby conveyor for a period of over more than 40 days. These were Timken tapered bearings operating at 35 r. p. m., and carrying a variable load of 2000 pounds per bearing under estimated op-

Continued on following page

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erating condition temperatures of 350-400° F. No other grease tested by this smelter had provided effective protection for these bearings. This performance is consistent with what could be predicted from a knowledge of the manufacture of the grease and its properties.

In the operation of its trains, a railroad company experienced occasional but embarassing and annoying failures of motor-generator bearings on the modern articulated units equipped with fluorescent lighting. In this case bearing temperatures were high but not excessive, and the precise explanation for failure has not yet been fully diagnosed. However, bearing temperature appears to have been a contributing factor. In any event, the use of Grease F in these bearings so greatly extended the life of the bearings that their maintenance is now considered by the operators to be on a normal basis.

A large food processor had adopted Grease F as a general purpose lubricant throughout his plant, since it offers full protection over such a wide range of temperature, regardless of the presence of moisture. It is felt that the versatility of the lubricant and its low consumption fully justify the initial purchase expense.

Grease F has also been used in many other anti-friction bearings, where temperatures in the vicinity of 300° F. constitute a severe challenge to ordinary grease lubrication. Under such circumstances this grease has yet to fail in providing satisfactory lubrication. It has been tested by a number of independent laboratories in bearings operating at high speeds for prolonged periods at 300° F., or even higher. In all cases, the grease has been outstanding among various lubricating oil greases. It also satisfies the requirements of such government specifications as AN-G-5a and 14-L-3c.

Grease F has been used to lubricate bearing points on aircraft where high temperatures are involved. Such high temperatures are encountered on bearing

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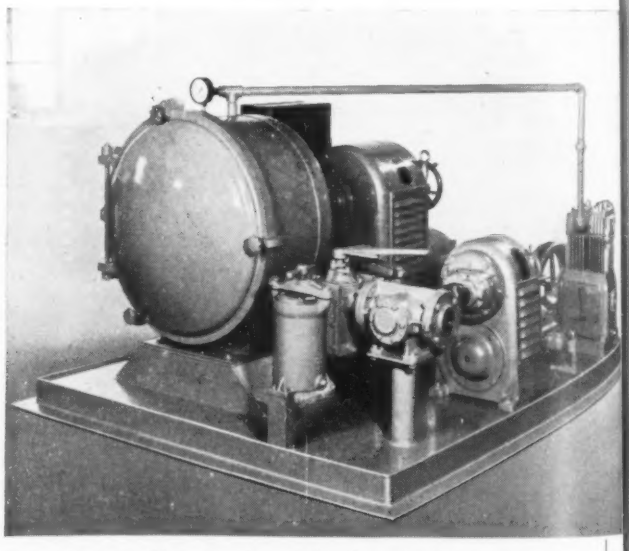

Grease Homogenizer, showing feed pumps, strainers and vacuum pump.

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points in the engine nacelle. The grease has been used in other bearings on aircraft, where bearing temperatures may fall within the operating range of 0-300° F.

Another interesting application of Grease F was found in connection with lubrication of kiln bearings as a substitute for conventional brick grease. The temperature of these particular bearings was estimated to run very high and great difficulty has been encountered in lubricating them, except with special brick greases. The incorporation of Grease F with wool yarn served as a highly effective substitute for brick grease.

The problem of lubricating glass joints on large glass distillation units has frequently presented difficulties through sticking, breakage, etc. The combination of water condensate, hydrocarbons, and heat presents formidable problems. Lubrication of such glass joints under severe temperature conditions was satisfactorily obtained by employing a special strontium grease of high soap content and containing a highly viscous residual oil.

Strontium grease of the type represented by Grease A has been used on bearings operating within the range of —40° F. to 250° F., and has found extended application as a general purpose lubricant on aircraft. Its stability in storage and use, its resistance to the leaching action of water and naphtha during washdown operations, its protective action against corrosion by moisture and salt spray, and its reversibility over wide ranges of temperature have made the grease an effective lubricant on air-

Continued on following page

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craft bearings. On a number of Trans-Pacific test runs made by a well known operating air line, the superior protective action of both Grease A and that described earlier, Grease F, against corrosion by salt spray and moisture was fully confirmed. Grease A has been used successfully as a general aircraft lubricant by a number of the prominent airframe manufacturers and airline operators. As far as is known, it has never failed to provide satisfactory lubrication. However, further studies are now being made with the object of making the grease still more versatile.

As indicated in Table 1, strontium greases of widely varying characteristics have been prepared. Several of these such as Greases A and F, have been effectively used for the lubrication of anti-friction bearings, particularly in those instances where other types of greases have failed to provide suitable service. Other strontium greases containing mineral oils of medium viscosity are currently being tested and it is anticipated that these will find wide application, particularly in those fields where general purpose lubricants of versatile characteristics are desired.

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REPRESENTATIVE STRONTIUM BASE GREASES PREPARED BY VARIOUS COMPOUNDING PROCEDURES FROM VARIOUS SOAP STOCKS AND MINERAL OILS

Composition or Test	Grease A	Grease B	Grease C	Grease D	Grease E	Grease F
Composition (By analysis)						
[a]Strontium Soap, %	26.0	26.0	23.0	29.5	21.5	26.5
Free alkali, %	0.1	0.1	None	0.1	None	0.1
Water, %	Trace	None	None	None	None	None
Oxidation Inhibitor Used	Yes	Yes	Yes	Yes	Yes	Yes
Mineral Oil, %	73.0	73.0	76.5	70.2	78.0	73.0
—SAE Grade	[b]	60	10	30	60	70
—VI	20	18	92	90	90	105
—Gravity, °API	25.8	20.5	30.4	28.9	26.8	26.5
Properties						
ASTM Penetration at 77° F. (Worked sample)	300	320	300	305	230	300
ASTM Dropping Pt., °F.	400+	400+	400+	400+	400+	400+
Oxidation Resistance	1	2	2	0	1	2
[c]Water Resistance (% lost)	<5	0	0	0	0	<5
[d]Copper corrosion	None	None	None	None	None	None
[e]Salt spray corrosion	<5	[f]	<5	<5	[f]	<5

[a]Complex strontium soap.
[b]150 SUS at 100° F.
[c]Pressure drop in 100 hrs. at 210° F. Initial oxygen pressure 110 p. s. i. Norma-Hoffman bomb.
[d]A.S.T.M.-D-130-41 method.
[e]Similar to method described in specification AXS-1169. (See Table 2.)
[f]Samples not tested.

Conclusion

It is clear from the foregoing discussion that strontium greases can now be considered a new class of commercial greases. They offer to the trade a type of grease that, so far as is known by the authors combines to a greater degree than other available lubricating oil greases the desired characteristics of a general purpose lubricant. Much work remains to be done to exploit this new class of greases, but it is evident that their development adds another note of interest to the future of the grease industry.

RESULTS OF SALT SPRAY TESTS ON STEEL PANELS COATED WITH VARIOUS GREASES[a]

Type of Grease	Corrosion of Steel Panel (surface area corroded, %)
Strontium—(Grease A)[b]	Less than 5
Strontium—(Grease F)[b]	Less than 5
Calcium[c]—NGLI No. 1	15-20
Calcium[c]—NGLI No. 4	10-15
Lithium[d]	75-100
Sodium[e]	90-100

[a]Method similar to that described in AXS-1169. Salt spray test for 100 hours at 95° F. No rust inhibitors added to test samples.
[b]See Table 1 and text.
[c]Conventional hydrated cup grease.
[d]Lithium grease prepared with lithium stearate and SAE 30 oil.
[e]Sodium wheelbearing grease prepared with tallow soap and SAE 40 oil.

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